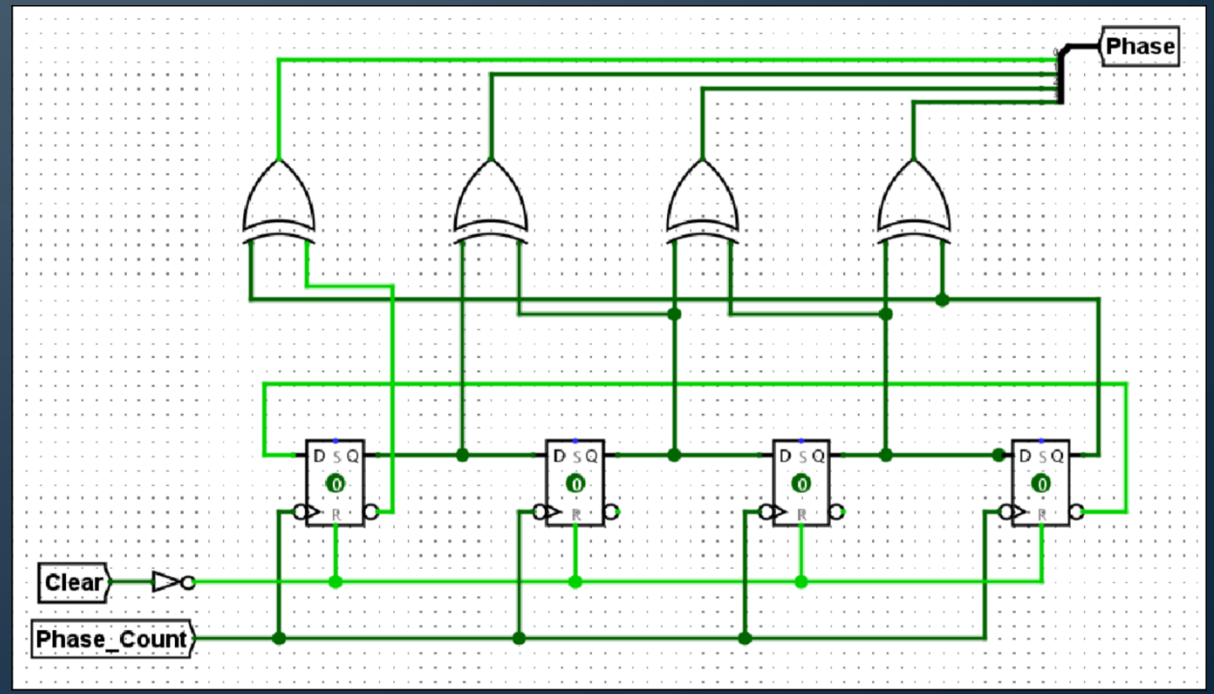
FINAL PROJECT: 4-BIT RING COUNTER

ABDULLAH BOHAMAD

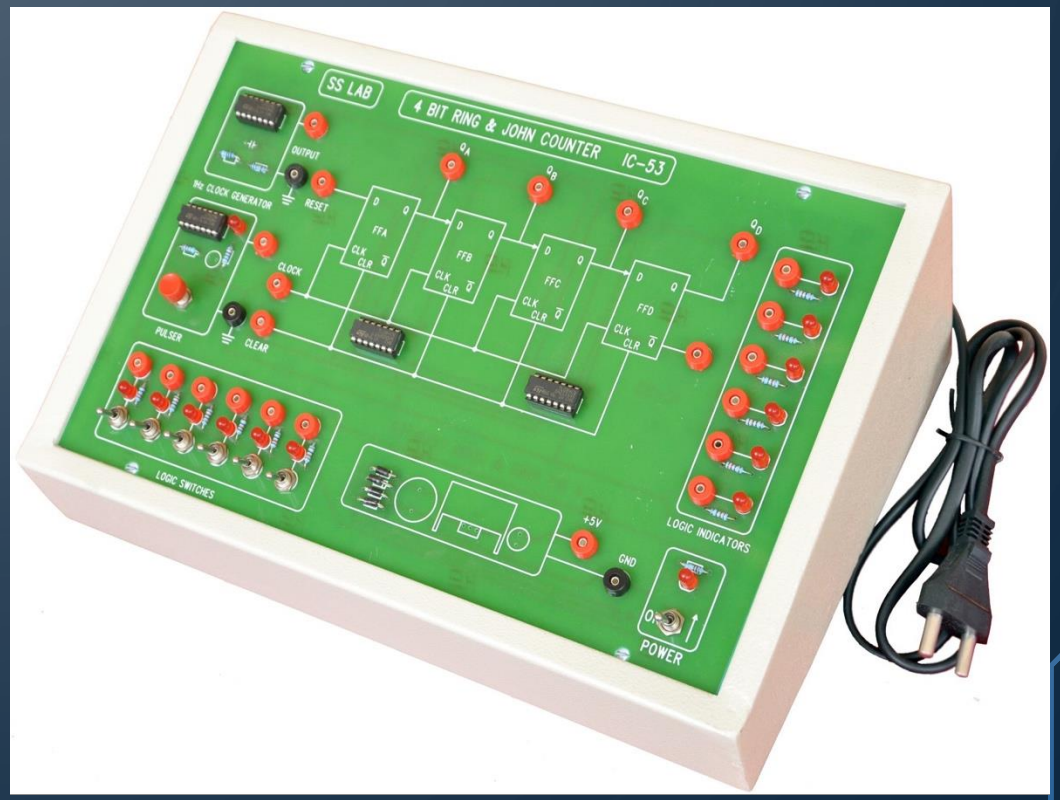


INTRODUCTION TO RING COUNTERS

- Digital counters used for timing/sequencing.

- Ring counter moves a single ‘1’ through flip-flops.

- Applications: clocks, LED chasers, state machines.



TOOLS AND COMPONENTS

- Electric VLSI Design System.
- SPICE simulations.
- muddLib07 standard cell library.
- Custom D flip-flop required.

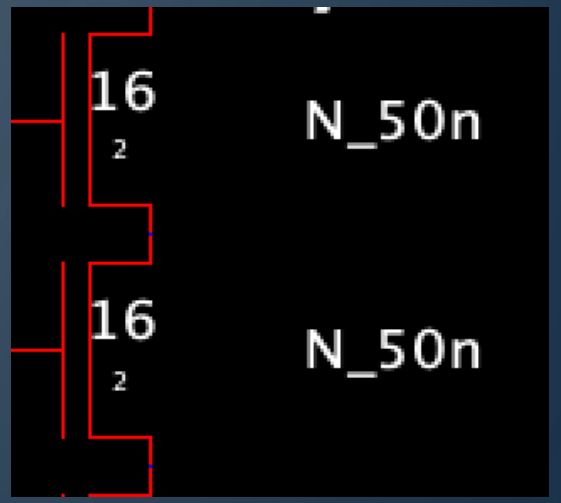
ASSIGNING SPICE MODELS TO PMOS AND NMOS

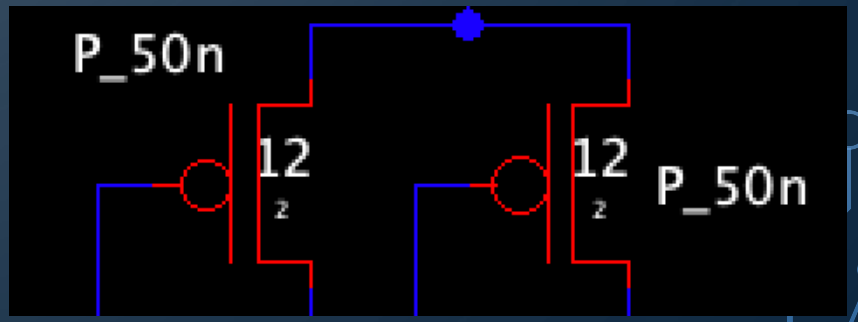
- Used SPICE transistor models from muddLib07.

- **N_50n** → assigned to all NMOS devices.

- **P_50n** → assigned to all PMOS devices.

- Ensured accurate device behavior during simulation.

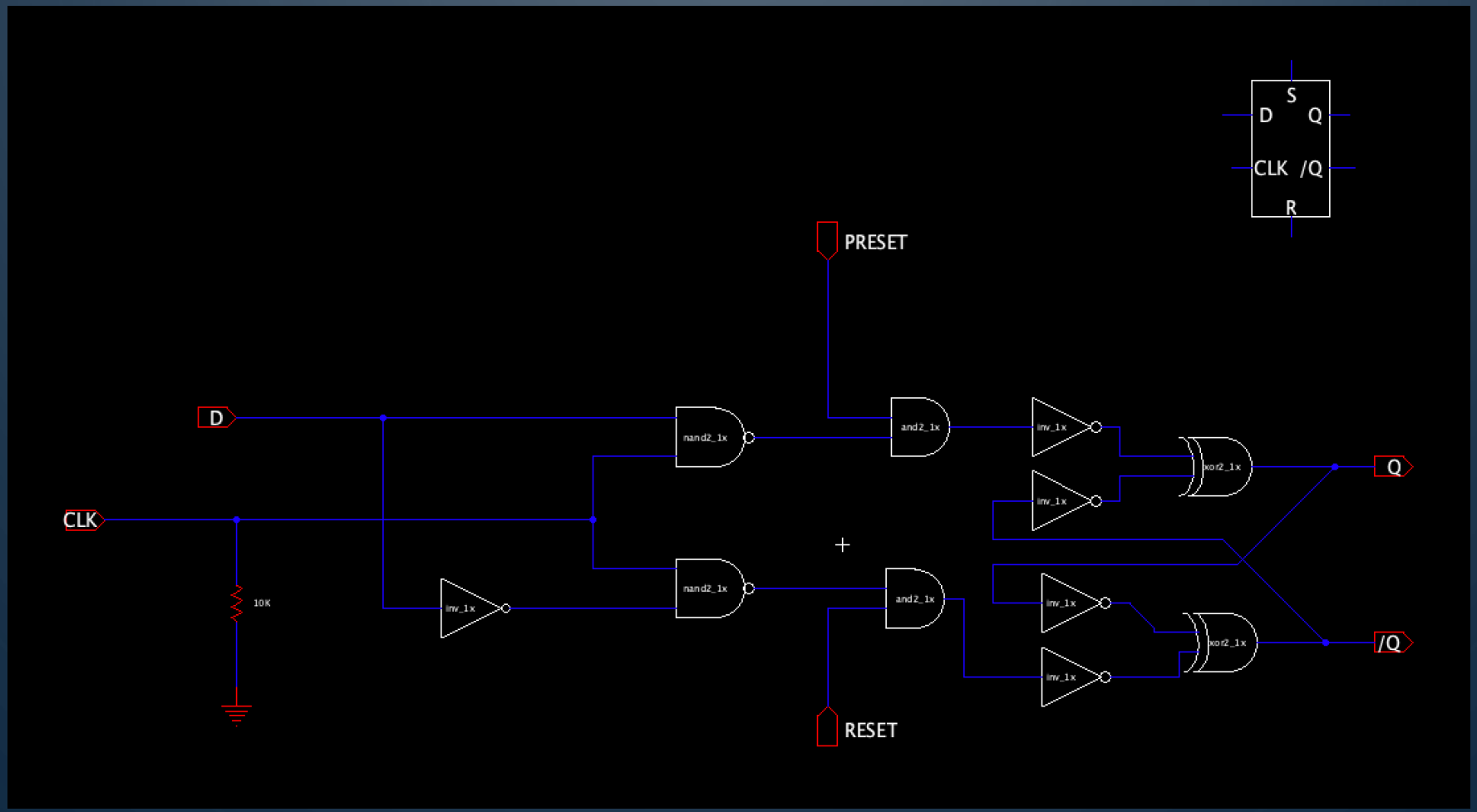




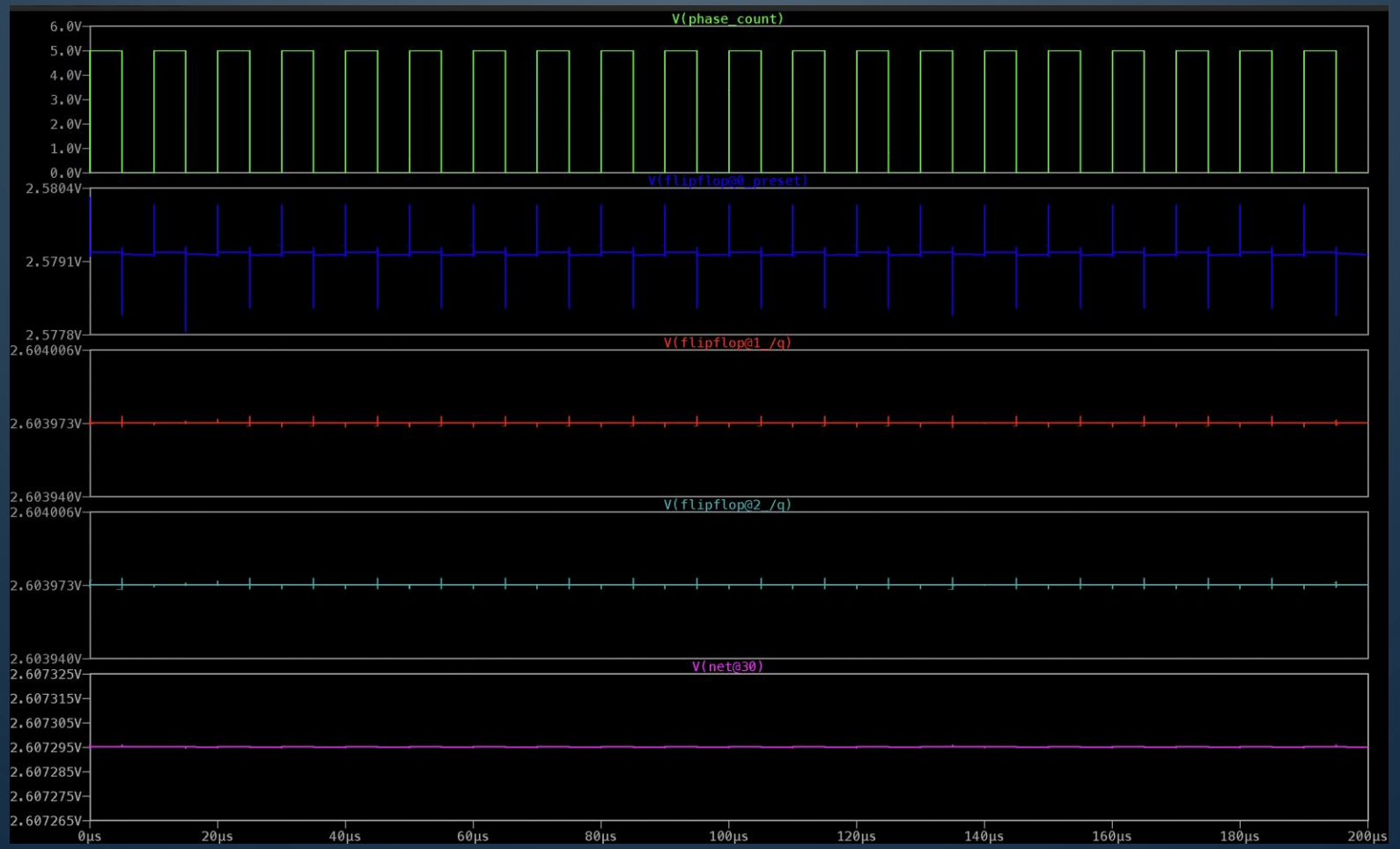
EARLY ATTEMPTS & FAILURES

- First custom flip-flop unstable.
- Mid-level voltages around 2.6 V.
- Incorrect preset/reset behavior.
- Missing proper initialization.

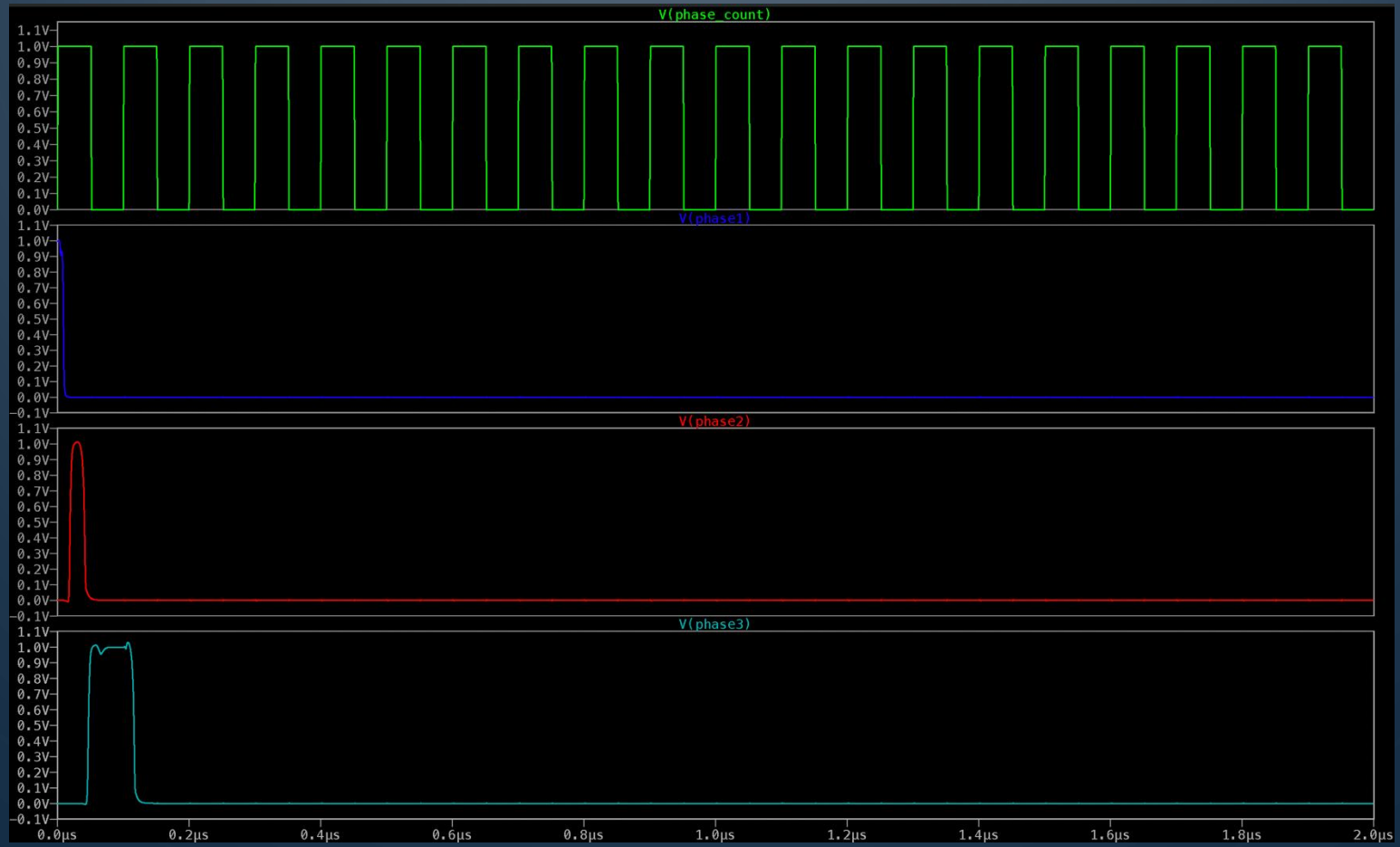
EARLY ATTEMPTS & FAILURES



EARLY ATTEMPTS & FAILURES



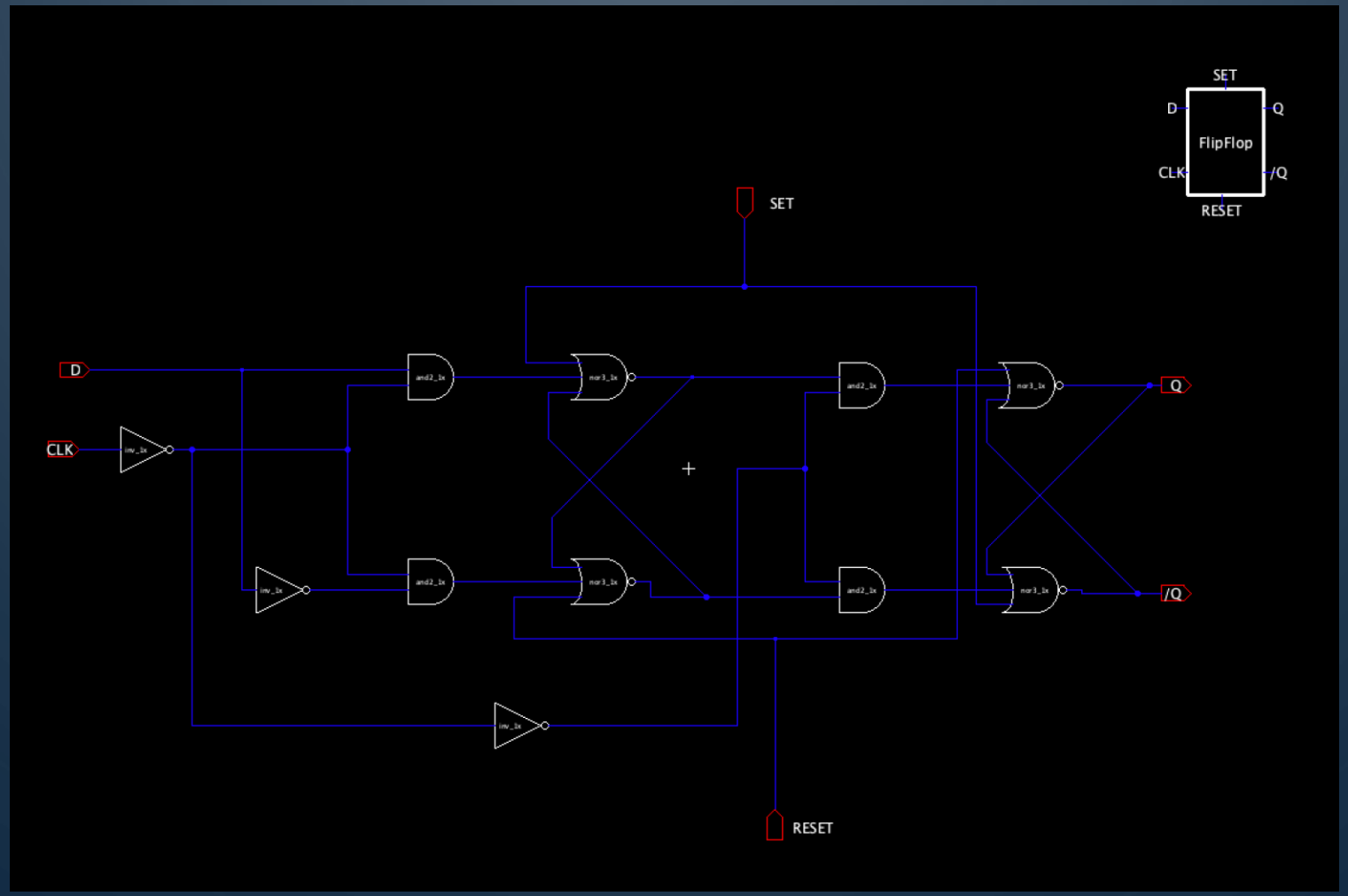
EARLY ATTEMPTS & FAILURES



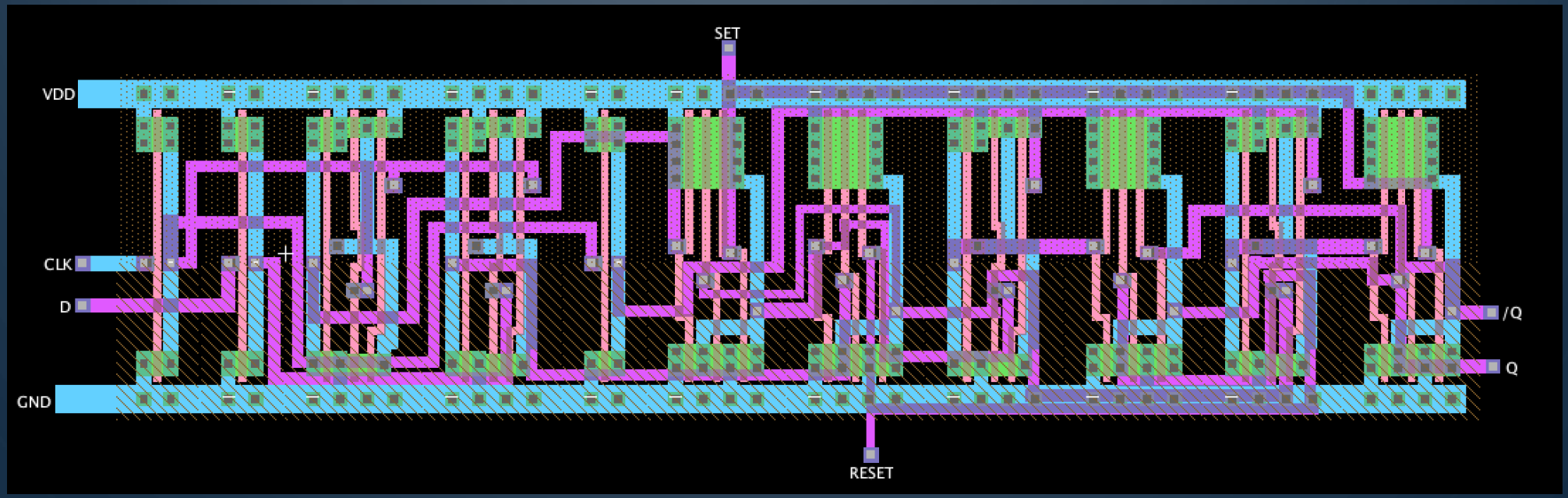
FINAL WORKING D FLIP-FLOP

- Reorganized gating and feedback.
- Clock-controlled AND gates.
- Regenerative NOR latch.
- Clean Q and $\overline{Q}$ outputs.

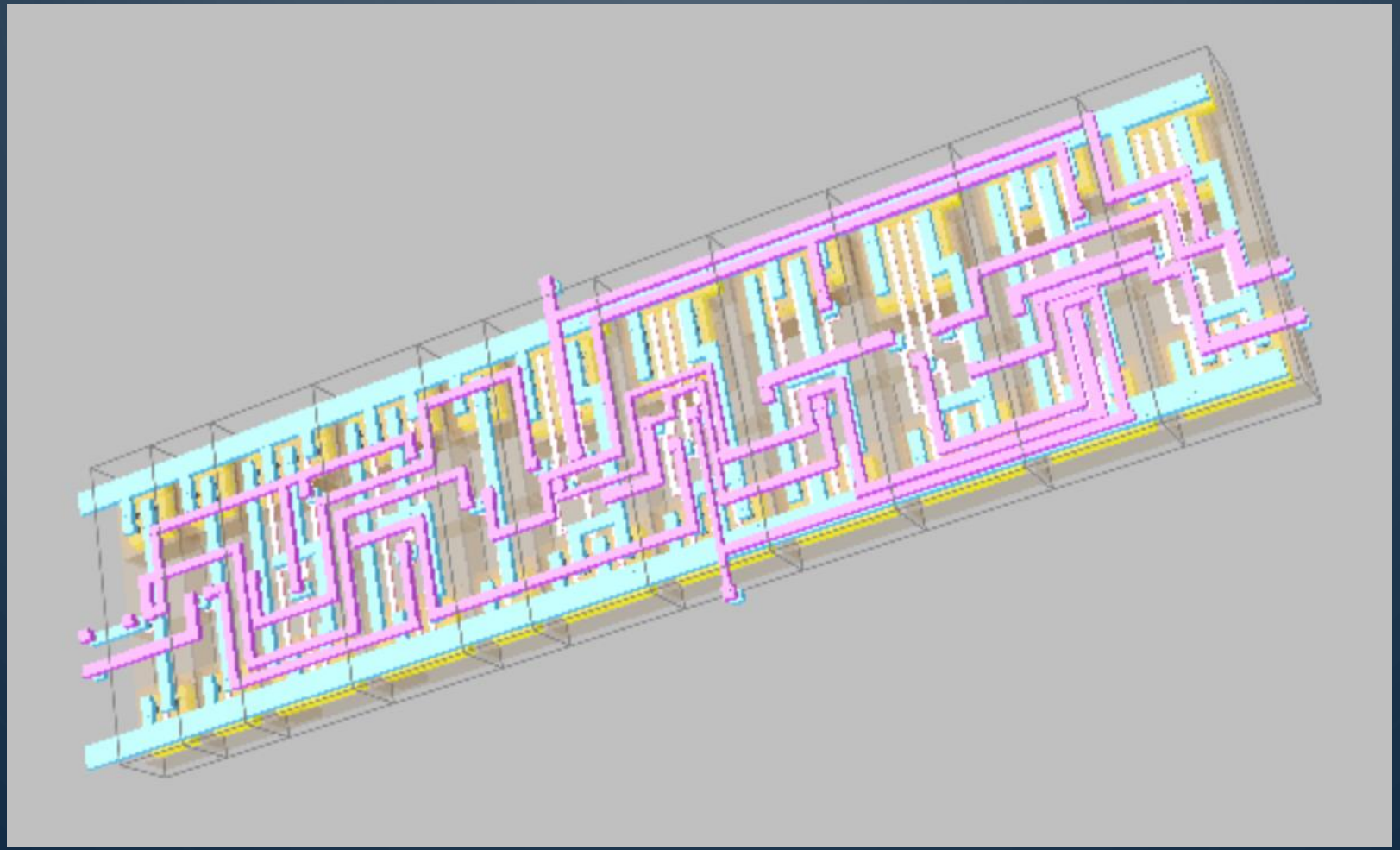
FINAL WORKING D FLIP-FLOP



FINAL WORKING D FLIP-FLOP



FINAL WORKING D FLIP-FLOP



FINAL RING COUNTER OPERATION

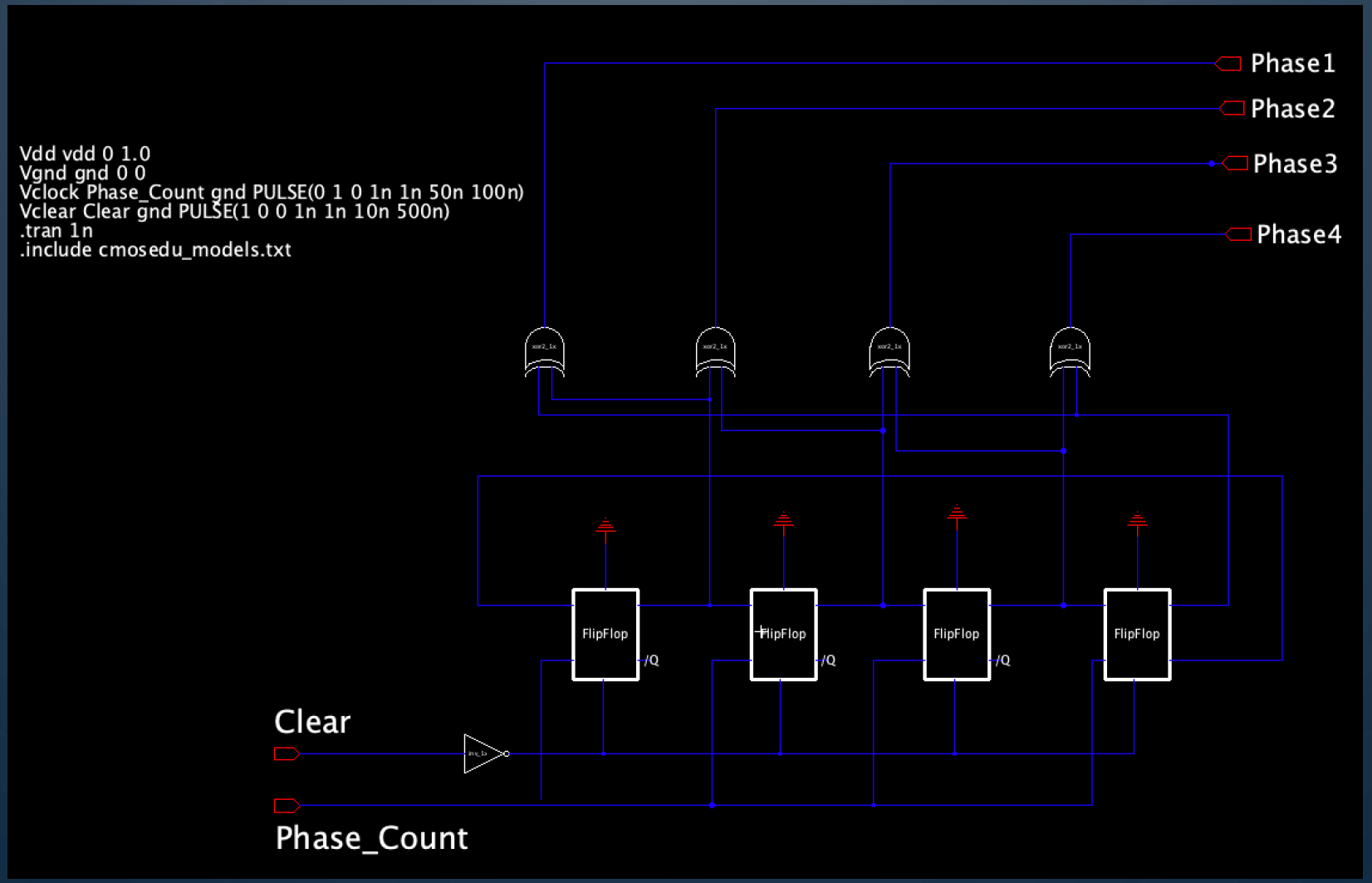
- Four D-flip-flops in a ring.

- XOR-based transitions.

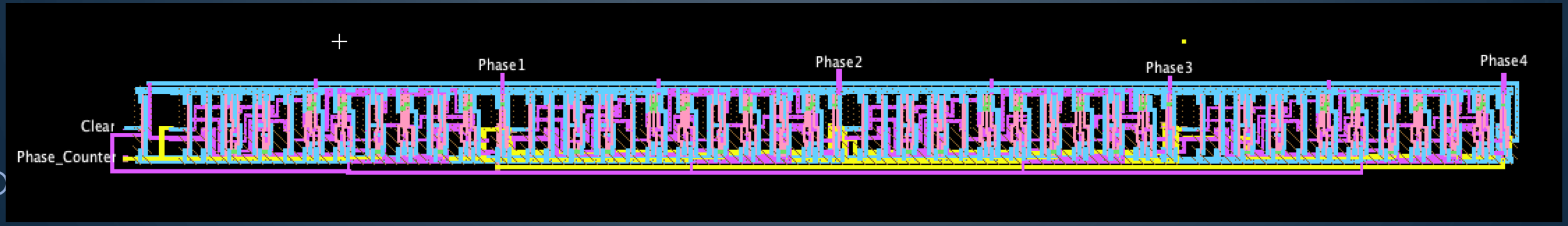
- Active-low Clear sets initial state.

- Waveforms show correct Phase1→Phase2→Phase3→Phase4 sequence.

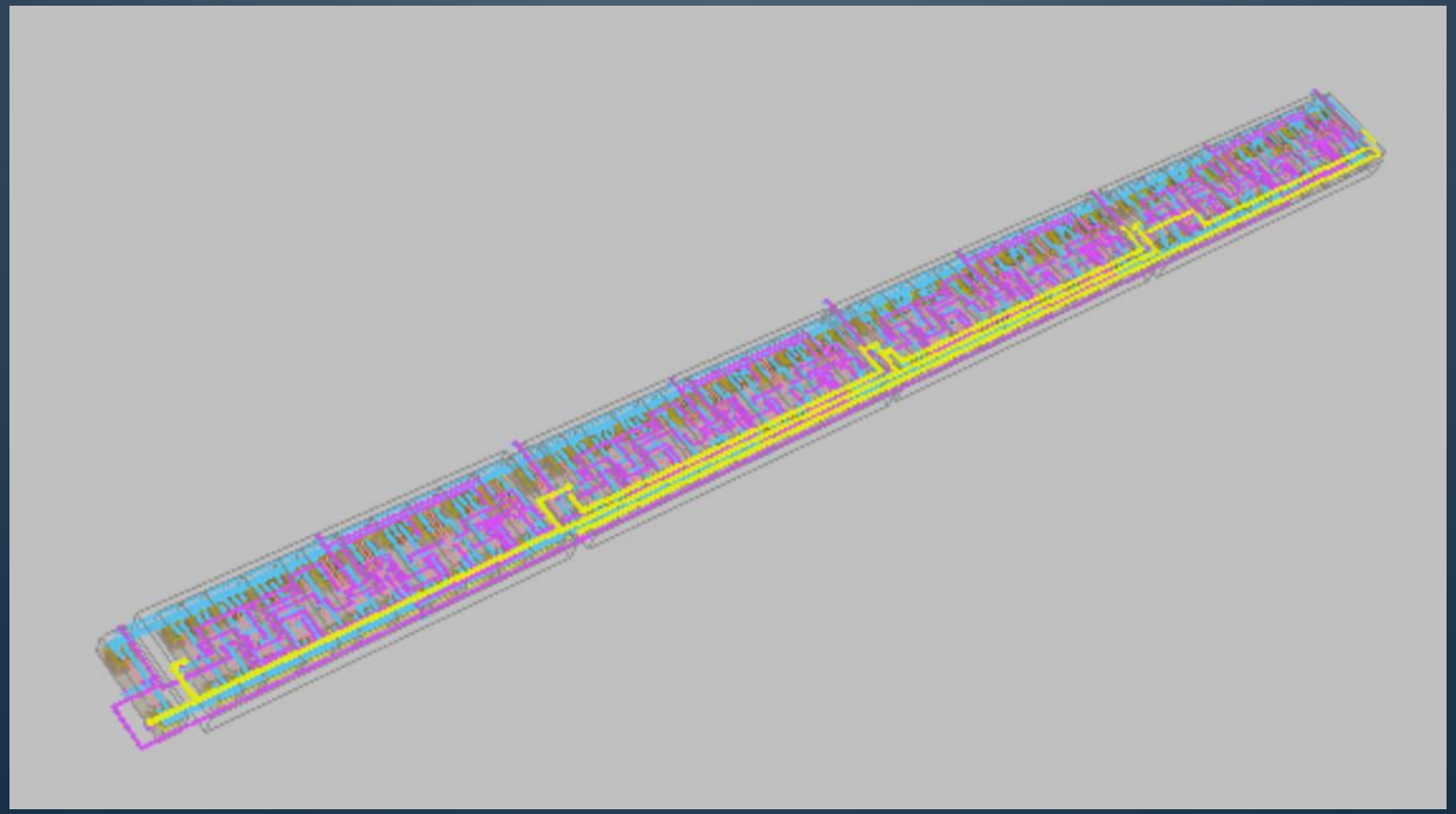
FINAL RING COUNTER OPERATION



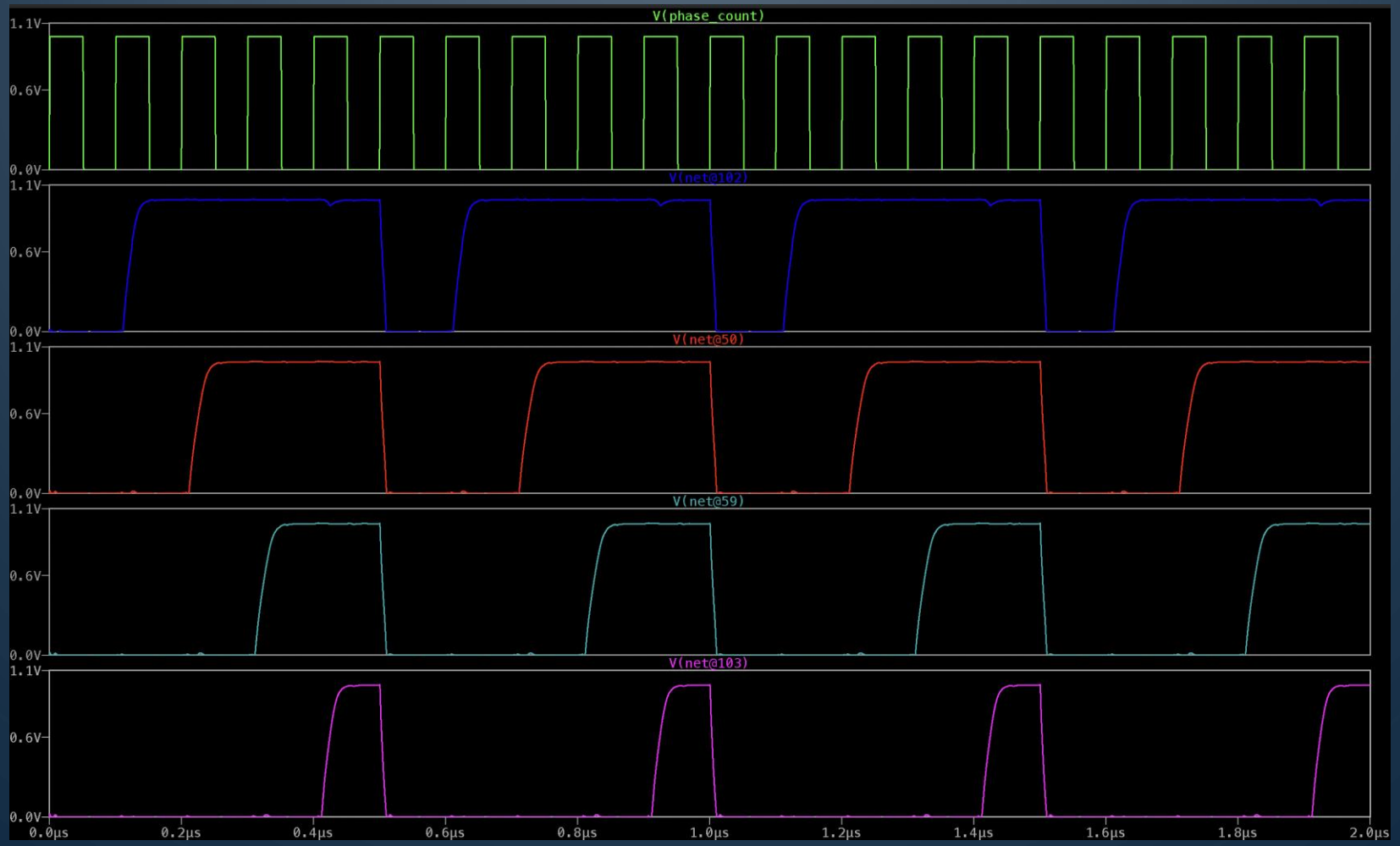
FINAL RING COUNTER OPERATION



FINAL RING COUNTER OPERATION



FINAL RING COUNTER OPERATION



THANK YOU FOR YOUR ATTENTION!